

# THE OPERATIVE TREATMENT OF GOITRE.

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WITHIN the last four or five years there have been so many diverse methods introduced for the removal of thyroid tumors that a collective review of the very extensive literature of the subject appears of some interest to the practical surgeon. Regarding the operative technique alone, there are at the present time at least ten different procedures in use for the treatment of goitre; yet, while all are recognized as legitimate operations, some bear identical, or very similar titles, and others are known only by the names of their authors. It is proposed here to enumerate and describe these various methods with a view to facilitate comparisons between them, as well as to attain some unity in the use of the terms employed in connection with these operations. Before turning to the operative technique proper, it is, however, advisable to glance cursorily at our present knowledge of the anatomy, both normal and morbid, of the thyroid gland; for it is largely due to comparatively recent advances in this direction that an operative interference with the thyroid growths has become modified.

The normal thyroid gland, with its two lobes joined together by a bridge-like portion, the isthmus, consists of a stroma of connective tissue forming septa between which the lobules of the gland are situated. These lobules are again composed of smaller divisions, which may be termed granules; and these are in like manner separated by trabeculæ of connective tissue. These granules are composed, in the fully developed gland at birth, of a number of follicles, regular in size and shape, each con-

sisting of a layer of nucleated cells in the periphery (epithelium), and a drop of gelatinous fluid in the centre. They are surrounded by soft connective tissue, bearing capillaries, which is termed the interstitial tissue.

We therefore have to discern between three kinds of septa, (1) the smallest, being the last-named interstitial connective tissue between the follicles; (2) the intermediate septa or trabeculae between the granula, or conglomerations of follicles, likewise bearing blood-vessels; and (3) the largest septa, separating the lobules of the gland and enclosing the largest vessels. These latter septa are in connection with the capsule of the gland.

In the foetal period, however, before birth there are no follicles present; but the granula contain larger masses of cells grouped together, either in round heaps or in elongated cords, and each is covered by a proper membrane. The follicles are formed at a later period by the cells arranging themselves into globular masses, in the middle of which a small quantity of gelatinous fluid is seen, which soon undergoes colloid degeneration.

Turning now to the minute anatomy of goitre, we find the main variation from the structure of the normal thyroid in the irregularity in the arrangements of the parts. At the beginning of the disease we not only find irregularities as to the arrangement of tissues, for there are well-developed follicles in close proximity to the larger solid masses of cells, globular or elongated, but also marked irregularities in the size of these formations. The clusters of cells, as well as the follicles proper, vary extensively in the size and in the number of cells contained in each, and the cells themselves vary, resembling at some points flat, and at others cylindrical, epithelial cells.

In the further development of goitre this irregularity is even more marked. The round groups and the solid cords mentioned above commence to grow by the division and subdivision of the cells contained in them: but not equally in all parts. In this manner the shape of the groups is altered; the cords become bifurcated or ramified. The next step is the formation of solid follicles within the groups, in the centre of which a small amount of gelatinous fluid appears; or else a

drop of the gelatinous fluid may appear in the midst of the solid clusters and the cells subsequently group themselves around them. In like manner the solid cords are formed into tubules. These tubules frequently open into each other in consequence of their irregular growth, and the follicles, too, often intercommunicate, by means of openings in the epithelial layers. These communications may become so marked that they form a reticular structure, in the meshes of which the interstitial tissue with the capillaries appears imbedded—and this is especially noticeable when cylindrical epithelium is present.

The irregularity in the development of these formations, the formation of new cells by division at certain points, is reflected in the macroscopical appearance of goitre. We there encounter nodes situated in various portions of the tumor, more or less removed from the centre, and consisting of tissue which may be either softer or harder than that surrounding them. Almost always they are covered with a layer of connective tissue: a capsule more or less pronounced; and they appear of varying size and shape.

It is easy to understand how irregularities in the developmental growth of the tissue may lead to the formation of these nodes; we need only imagine that varying numbers of cell formations take part in the production of the nodes, and that the commencement of their growth is not simultaneous.

These forms of goitre exhibiting nodes may be classed together under the heading "*struma nodosa*," for practical consideration. It is probable that all pathological changes in the thyroid gland commence, as above described, by a proliferation of the cells of the parenchyma. The elongated masses of cells push their way out into the connective tissue surrounding them, and then become converted into follicles and tubules. This form of *struma nodosa* is termed *struma hyperplastica follicularis*, and is remarkable for the softness of the nodes.

The connective tissue surrounding these follicles may, however, commence to proliferate; it inserts itself between the follicles, surrounds the tubules, and by contracting chokes off parts from them; subsequently much of the parenchyma may be thus destroyed, and the connective tissue is found in its

place This is *struma hyperplastica fibrosa*. In this form the nodes are extremely hard.

Again, the capillaries may play an important part in the proliferation, and we have then *vascular hyperplasia*, which may be subdivided into the aneurismatic and the varicose forms, according to whether the arterial or the venous vessels predominate. There is also an amyloid form, the capillaries having undergone amyloid degeneration.

These forms may present certain combinations. The parenchyma may remain comparatively unchanged in the periphery of the nodes, presenting solid cell clusters and cords and follicles, while the connective tissue and capillaries undergo hyaline degeneration in the centre. Or, again, the periphery may show the same forms as before, but fibrous or calcified masses may appear in the centre.

A frequent occurrence is the conversion of nodes into cysts. This may take place by hyaline degeneration of the connective or fibrous tissue (degeneration cysts); or else by hyperplasia and enlargement of the follicles, so that they encroach upon and rupture into one another (dilatation cysts).<sup>1</sup>

It is probable that these cysts increase in size, in consequence of small hæmorrhages which take place into the cyst when the surrounding tissue undergoes colloid degeneration. Every tissue-formation in goitre may undergo this colloid metamorphosis, including the vessels and their contents; but, unfortunately, our knowledge of the chemistry of colloid masses is very limited, and this is one of the principal reasons why our understanding of thyroid pathology is still so limited.

We have hitherto turned our attention solely to the *struma nodosa*, where proliferation takes place only at certain points, and in an irregular manner.

<sup>1</sup>Gut Knecht classifies *struma nodosa* in the following manner:

- I. Nodes consisting of hyperplastic parenchyma (*struma colloides*).
- II. Nodes with hyaline degeneration in the centre and solid cell-masses or colloid follicles in the periphery (medullary form).
- III. Nodes with preponderance of fibrous connective tissue in the centre, or calcification, the periphery being as before. (Nucleated form.)
- IV. Nodes with vascular hyperplasia.
- V. Nodes representing cysts.



If the proliferation of the parenchyma takes place equally throughout the whole gland, we speak of hypertrophy. If only the number of cells are increased, we term it *struma hypertrophica parenchymatosa*; if, however, the size of the follicles and tubules are increased in consequence of a dilatation by their contents, we have *struma hypertrophica gelatinosa* or *struma colloides*. The cells are not equal in size.

We must now briefly refer to the term, adenoma, which is frequently used in speaking of the enlargements of the thyroid body. *A priori*, there is no reason why both the hypertrophic forms, and, especially, the hyperplastic forms, should not be termed adenoma, for the analogy to such growths in other organs is present.

But Wœlfler, who has given special attention to the histology of struma, and is the most copious writer on the subject, uses the term adenoma with a special signification, and it is best, in the opinion of the present writer, to use the term adenoma only in connection with Wœlfler's name; or, at least, to use it only in the same sense with this author, in order to avoid confusion in the nomenclature.

Wœlfler believes that when the cell-clusters and cords, referred to above, have once developed into perfect follicles and tubules, there can be no further development nor hyperplasia. He believes, however, that there may be lodged in the interstitial tissue, between the follicles and tubules, certain embryonic cells, misplaced here, as it were, in the formative period of development, which may at any time proliferate and develop into well-formed follicles and tubules, no different in appearance from the older ones. Wœlfler's adenoma is therefore understood to mean a new growth of parenchyma-cells within the interstitial tissue, forming new follicles between the older follicles, while these latter increase in size only; for this form we adopt the term *adenoma interacinosum*. But, as Wœlfler's nomenclature is not generally accepted by all writers, and would add nothing to the perspicuity or intelligibility of this review, we may better disregard it for the present. Suffice it to say, that the various forms of Wœlfler's adenoma (of which there are at the least six) belong under the heading struma nodosa. These nodes, according to Wœlfler, are easily

enucleated, excepting in the case of what he terms malignant adenoma, in which forms the nodes cannot be detached from the surrounding parenchyma.

Turning now to the more malignant growths of the thyroid, we find, although rarely, unmistakable specimens of primary carcinoma and sarcoma of the gland. But apart from these, there is a form of malignant, cancerous tumor of the thyroid body, which on account of its close relation to goitrous tumors and in contradistinction to the true carcinoma just referred to, is termed malignant goitre, or struma maligna.

On examining this class of tumors, we find the greater part of the structures resembling one of the other forms of goitre; but at certain points, one or more, the cells suddenly appear grouped in clusters, supported by a stroma of connective tissue, representing an unmistakably carcinomatous picture.

The chief point of interest in these malignant forms of goitre is their ability to cause metastasis; and in the metastases so formed we may again have tumors resembling simple goitrous tissue, with little analogy to malignant growths, except at certain points. These metastases may occur below the sternum, under the maxilla, or in the lungs. In any case, however, whether the thyroid tissue of these tumors appears malignant or not, the clinical course is always malignant. They probably turn into cancers.

We now turn to the subject of the vascularization of goitre. This theme has been the subject of special study by Anna Begoune.

The four arteries supplying the goitres are the two superior, and the two inferior thyroid arteries. The superior thyroid from the external carotid, divides into two branches before entering the capsule of the upper portion of the thyroid body, and afterwards sends its smaller branches into the gland along the septa. In some cases there are three branches, when it is greatly developed.

The inferior thyroid artery enters the gland from below posteriorly, also divided into two branches, between which the recurrent nerve is said to lie in some cases. These branches also nourish the isthmus. These two systems do not anastomose so that the vessels of the inferior thyroid cannot be in-

jected by injection of the superior, and *vice versa*. On the other hand, however, a great part of the trachea, the larynx and epiglottis, and portions of the œsophagus can be injected through the thyroid arteries.

Occasionally (once in ten cases) there exists also a thyroidea ima artery, which should be borne in mind, when ligation of the arteries is practiced.

The veins met with during operation are generally abnormally enlarged, and appear formidable on this account. They require double ligation. The subcutaneous veins of the neck, the external jugular, the oblique jugular, the anterior jugular may be met with in dealing with the superficial tissues. Beside the veins accompanying the large arteries supplying the gland proper, we frequently find accessory veins, which require attention. There are the *venæ thyroideæ superiores accessoriae*, the *vena communicans superior* (between both superior thyroid veins), the *venæ thyroideæ inferiores accessoriae*, and the *venæ thyroideæ imæ*, of which there may be two, connecting the left lobe with the *vena anonyma*.

The veins accompanying the arteries course in the capsule of the gland for a greater extent than do the arteries.

In the goitrous tumors which we have termed hypertrophic, the vascularization is analogous to the normal gland in infants; the capillaries lie in the interstitial connective tissue between each follicle. The nodes in *struma nodosa* are, however, ill supplied with vessels; in cystic formations, too, the vessels are for the most part destroyed.

Where we encounter thickened capsules, as in larger cysts, the blood vessels follow a general rule; the larger vessels supplying the capsule advance toward it at right angles to it; but in the capsule itself they all run parallel to its superficies.

As to the nerves which require consideration, there are four. The sympathetic, the pneumo-gastric, the hypoglossus have all been injured during operations upon *struma*, and have been made accountable by some for a sort of cachexy consequent upon removal of the gland, known as *myxœdema* or *cachexia thyropriva*.

One pneumo-gastric nerve may be cut without occasioning any untoward symptoms. Lesions of the sympathetic pro-

duce exophthalmus, dilation of the pupils, a frequent pulse, and vasomotor disturbances. Severing of the hypoglossus causes unilateral paralysis of the tongue.

The recurrent laryngeal nerve has received the most attention, on account of its close proximity to the inferior thyroid artery, and because of its frequent injury during operations for goitre, the immediate consequence of which is unilateral paralysis of the vocal chords.

The exact anatomical relation of this nerve to the inferior thyroid artery varies in the cases. In one-third of the cases the nerve lies in front of the transverse portion of the inferior thyroid artery; in another third it lies behind, and in the rest of the cases it lies between the branches of the artery, before they enter the gland. On this account ligation of the inferior thyroid artery should be done at a point as far as possible removed from the gland, near its origin; or else the branches should be separately tied at the points where they enter the capsule of the gland. At the point where the inferior thyroid artery alters its course from the vertical to the horizontal direction no injury to the recurrent nerve is to be feared, but here injury may be done to the cardiac branches of the sympathetic.

The points where the recurrent is the most exposed to injuries are: firstly, in the angle between the superior margin of the isthmus and the upper cornu, where it advances toward the muscles of the larynx; and, secondly, further below, in the groove between the œsophagus and the trachea.

Finally, a word must be said in regard to the capsule of the gland. The gland is frequently spoken of as covered over with two layers of tissue: the fascial fibrous sheath, which is generally termed the capsule of the gland, but which should not on any account be confounded with the proper capsules enveloping the nodes or the cysts of goitre; and, immediately beneath this, the tunica propria of the gland consisting of connective tissue. But these conditions are limited to struma nodosa, and limited also to those parts where the enlarged nodes lie adjacent to the capsule of the gland—this tunica propria being nothing else than the thin layer of parenchymatous tis-

sue enveloping the nodes, which has undergone transformation into connective tissue through pressure.

We have given these anatomical data at what may appear unnecessary length in order to render the following survey of operative methods more comprehensible and concise. We now turn to the consideration of the methods of operating for goitre. For the present, however, we do not consider the forms of goitre where the tumor is represented by one large cyst; nor do we, for the present, take into consideration the treatment of goitre by injections with iodine, arsenical or other solutions, but merely the operative interference with a view to the removal of the tumor.

There are at the present time at least eight recognized methods of thyroidectomy, either partial or total, without including the variations of each, and almost all the terms generally applied to surgical procedures have been used in connection with goitre, not excluding "resection" and "amputation."

It is of some advantage to be able to designate an operative method for the removal of goitre by a single term, and without necessarily mentioning the name of the author first introducing it; so that in the following pages we shall adopt the nomenclature generally accepted for specifying the operations.

We distinguish between (I) extirpation (Kocher), (II) enucleation (Socin), (III) resection (Mikulicz), (IV) amputation (Nussbaum), (V) evacuation (Hahn), (VI) evidement (Kocher), (VII) temporary deligation (Bose), (VIII) ligation of the afferent arteries, and (IX) combinations of the above, such as Kocher's combined enucleation and resection.

I. We begin with the classical extirpation of goitre, as described by Kocher in 1883, and still used in the main by him.

(a) The incision through the skin and superficial fascia runs upward in the median line from the sternum to the cricoid cartilage; from here at an oblique angle (which should be, however, well rounded) to the upper part of the sterno mastoid muscle. This line of incision meets the anterior and oblique jugular vein at a more or less acute angle.

(*b*) The muscles overlying the thyroid body are now cut through at the same points where the skin was incised.

(*c*) The gland being now exposed, the superior thyroid artery is secured, as are also (*d*) the large veins: the superior thyroid, the communicating superior, and accessory superior thyroid veins, as well as the inferior, the inferior accessory, and the communicating inferior thyroid veins, and the ima. Kocher first called attention to the importance of ligating these veins.

(*e*) The next step is to split the capsule of the thyroid body—that is to say, the external one, but not on any account the inner proper capsule.

(*f*) The capsule is now to be stripped off the tumor until (*g*) the tumor can be turned out of the wound.

(*h*) The inferior thyroid artery is now to be ligated at a point close to the carotid artery (not near the tumor); after which (*i*) all vessels entering from behind are caught, and then it is only necessary to (*j*) isolate the isthmus and cut off the tumor.

In this way one lobe of the thyroid is extirpated, and in case removal of the other half should be indicated, the process may be repeated on the other side. In this manner Kocher has operated upon some 400 cases, doing at one time 89 and at another 71 consecutive cases without a mishap. In his last report on 250 cases he places the mortality percentage at 2.4 % for all cases: Excluding malignant forms, however, and five cases of exophthalmic goitre (Grave's disease), the mortality percentage was only eight-tenths of one per cent.

As regards the method of this operation, the fear of injury to the recurrent laryngeal nerve has led its author to tie the inferior thyroid artery at a point as far removed from the body of the tumor as is consistent with the safe avoidance of the cardiac branches of the sympathetic; and by exercising due care not to injure the recurrent above the isthmus, where it approaches the larynx, the operation does not threaten the integrity of the nerve, since it need not be exposed where it lies in the groove between the trachea and œsophagus. As regards the technique during the operation, all irrigation is done away with as unnecessary, and silk is used throughout for



ligatures and sutures—catgut being discarded. After all arteries have been definitely tied, the wound is closed, and sublimated dressings applied.

This operation of Kocher's is termed the extra-capsular method of extirpation, because all the veins are tied, as is also the superior thyroid artery, before the capsule of the gland is incised.

The excision of goitre as described by Zesas, and done at Niehans' clinic at Bern, differs very little from Kocher's extirpation. The incision and the ligation of the superior thyroid artery are the same; the inferior thyroid is also ligated at a central point in the same way. Then the isthmus is ligated with an elastic ligature, and cut through, and lastly the tumor is separated from the trachea.

E. Rose, however, commences by cutting the isthmus, and then extirpates each half, tying each vessel as he encounters it. Rose, it must be remembered, performed tracheotomy immediately before the extirpation—a practice which has now been discarded in consequence of the many undesirable complications in the wound arising therefrom. In other cases, however, Rose left the isthmus uncut until he had freed the tumor, beginning in the region of the carotid, and applying ligatures continually as he proceeded. In some cases 200 ligatures were thus required, and much time and patience besides.

In contra-distinction to the extra-capsular method of Kocher, Billroth operates by the so-called intra-capsular method of extirpation. As soon as the thyroid body is exposed, the capsule is first slit up on a grooved director; the tumor is then enucleated as much as possible by blunt force, all veins and cords being doubly ligated and severed as they are encountered, running from the capsule to the gland. Frequent use is made of ligatures *en masse*. The inferior thyroid artery is to be tied after perfect isolation, with a view to avoiding the recurrent laryngeal nerve.

Kocher's first and original method was also an intracapsular one, but was abandoned prior to the year 1883.

Maas, whose method is accurately described by Rotter, operates from below upward, instead of, as does Kocher, from

above downward, and also uses an intra-capsular method. The incision is linear, parallel to the sterno-mastoid muscles, the flap containing the platysma. The muscles are now cut through transversely, the sterno-mastoid being again sutured, if cut, after the operation. The capsule of the gland is now incised upon the grooved director, and the gland turned out by blunt force. The inferior thyroid artery is now ligated at a point removed from the trachea; the superficial vessels supplying the inferior portion of the lobe are now tied, and the inferior portion made free. After this the upper portion is isolated and the superior thyroid artery and veins ligated. The gland now attaches only to the trachea, and may be pulled out towards the middle line, care being taken not to exert too much traction upon the trachea, and to avoid the recurrent laryngeal nerve. The isthmus is now tied *en masse* with silk, and cut off with the knife or galvano-cautery. In case total extirpation is indicated, this procedure is repeated on the other side. Maas uses a 2% solution of acetate of alumina for irrigation, chromated catgut for sutures, and a sublimated dressing prepared with sodium chloride—the whole being covered with protective. He operates, like Rose, with the patient in a half-sitting posture, and uses Thiersch-Nussbaum's combination of morphine and chloroform anæsthesia, ether being avoided as causing laryngeal irritation and coughing.

Baumgartner has proposed a modification of Kocher's manner of tying the inferior thyroid at a point removed as far as possible from the tumor. He argues that since a great part of the œsophagus, a large portion of the larynx and the trachea, are all supplied by the inferior thyroid artery (as Roux has shown by injection), it is not advisable to ligate after Kocher's manner. He, therefore, catches the inferior thyroids in hæmostatic forceps until the tumor has been removed, when he applies the permanent ligature; and can then be sure not to include the nerve in the ligature. But we should not forget that if once the recurrent nerve should be unintentionally caught in the forceps together with the artery, its function would be as surely destroyed as if it had been cut.

II. The operation termed enucleation was first introduced by Socin. Its performance depends upon the recognition of

the nodes, the formation of which is described above; as there stated, they are present in almost all cases of goitre. These nodes being surrounded by a membrane or capsule more or less thick, and lying immediately imbedded in the normal parenchyma of the gland, may be readily enucleated with blunt force, if the capsule can only be found, which in some cases proves the most difficult part of the operation. If the capsule of the nodes be situated superficially in the thyroid body, then the layer of sound thyroid tissue overlaying it may be very thin, and altered in its character so as to present the macroscopic appearance of connective tissue. In these cases it is nevertheless absolutely necessary to divide this layer in order to do the enucleation.

The exact method of proceeding differs in each case according to the number and location of the nodes. They may be attacked from the front or laterally, and either singly, each through a separate incision through the gland substance, or two or more may be enucleated by means of one single incision. The only hæmorrhage encountered during the operation is that during the incision through the parenchyma of the gland down to the capsule of the nodes. This may be controlled by the use of flat hæmostatic forceps; but during the enucleation of the nodes proper, there is very slight hæmorrhage, and this is easily controlled by compression. No large vessels enter the capsule, nor is there a pedicle or hilus to these nodes, requiring ligation.

This method has given excellent results in the hands of Socin as shown in the 50 cases published by Garre. The technique is easy of accomplishment; the operation is not a dangerous one; there can be no apprehension of secondary hæmorrhage, of interference with important nerves, or of tetanus or myxœdema—and it has been claimed, moreover, that the operation is not so disfiguring as some others. The wounds heal quickly with little danger of complication arising, such as acute thyroiditis, as the connective tissue spaces are not opened. Naturally, however, the operation is not applicable to all thyroid tumors, but only to those that actually present nodes on section, or, in other words, to all those forms of goitre which we have classed as *struma nodosa*. Inasmuch as this class is

by far the most frequent, we admit the usefulness of this method of enucleation; but we must bear in mind that this operation is not in any way possible in the class designated as struma hypertrophica or in any forms of malignant goitre. This operation has also been termed intra-glandular enucleation to distinguish it the more readily from the first described method of intra-capsular extirpation. The mistake is frequently made of attributing this method of enucleation to Juillard, who called his partial intra-fascial extirpation by this name. Porta, however, is said by Kocher to have operated by enucleation.

III. The so-called resection of goitre is an operation first described under that title by Mikulicz. Obalinski remarks that this method was practiced in 1871 in America by Green. The method is described by Trzebicky. The incision through the skin may be made along the anterior border of the sternomastoid muscle, or in the median line, with a second incision, if necessary, along the hyoid cornu. After having thus exposed the tumor, one of the lobes is freed from the surrounding tissue with blunt instruments. The superior thyroid artery and vein is then ligated, as well as the superficial vessels supplying the inferior portion of the lobe. The isthmus is now separated from the trachea by dry dissection, doubly ligated, and cut in two between the ligatures. The lobe is thus freed from its attachments in all but its lower part. Here it adheres to the trachea and œsophagus, lying in the angle between them, and covering the inferior thyroid artery (which is not ligated) and the recurrent nerve. This portion is now treated as if it were the pedicle of a tumor. It is divided longitudinally into several strands; each strand being compressed for a short space in hæmostatic forceps for the purpose of forming a groove for the ligature to lie in; a ligature is then applied to each strand and the tumor cut away. In case any further hæmorrhage should appear in the stump thus formed, transfixion ligatures are applied. The remaining stump should have about the size of a horse-chestnut and remains attached to the loose tissue uniting it to the trachea and œsophagus, and to the inferior thyroid artery and to the deep vessels attaching to the lower lobe.

The wound is now to be drained and sutured, and primary union is expected. In only one of twenty-one published cases did primary union fail; in nine cases out of twenty-three both lobes were removed in one sitting; in five, in two sittings. In the rest of the cases only one lobe was removed. In no case was there a recurrence of the malady.

Mikulicz claims for this method of resection that the recurrent laryngeal nerves are not exposed to injury. But Kocher frequently noticed sudden hoarseness due to injury to these nerves at the time of applying the ligature *en masse*.

IV. Amputation of goitre, as may be expected from the above description, differs very little from resection as to the parts removed, and the term "amputation," introduced by von Nussbaum, is only used to designate the technical fact, that the thermo-cautery is used to separate the tumor from the so-called pedicle, the tumor being well drawn out of the wound, but the pedicle remaining adherent to the trachea.

This method was used in cases of malignant, sarcomatous goitre only, where no other method was available. The division with the actual cautery was done slowly and cautiously, so that no loss of blood should occur. As much as one-quarter of the tumor was left *in situ*. The wound was left open in these cases and only covered with an antiseptic dressing. Very good results are reported to have been achieved by this method.

V. Evacuation is another method employed in the removal of thyroid tumors. It was first published under the title, "A Procedure to Remove Portions of Any Desired Size From Goitres Without Tamponade or Loss of Blood," by Hahn.

This author first applies ligatures to the superior thyroid arteries and to the thyreoidea ima artery, but places only hæmostatic forceps on the inferior thyroid arteries. In this way he hopes to prevent any serious injury to the recurrent laryngeal nerves.

He now splits the capsule of the gland and can now take out any desired portions of the tumor with the forceps and scissors. In this way he operates inside the capsule of the gland, first in the one lobe, and then, if necessary, in the other. This procedure can be done without loss of blood, provided

the small vessels in the capsule have been ligated at the time of its incision.

After sufficient diseased portions have been removed, the wound is treated by tamponade; but the hæmostatic forceps are left on the inferior thyroid arteries for the next twenty-four hours; and after the lapse of some further days secondary sutures are applied. Recovery is usually complete on the tenth day.

The advantages claimed for this method of evacuation are that the operation can be done without pulling or squeezing the gland, and without any injury to the recurrent nerve. But the placing of hæmostatic forceps upon the inferior thyroid branches needs to be done with equal care with that of a ligature. For should the nerve be caught in the grasp of the forceps, its function would be just as effectively interfered with as if caught in a ligature, even if the forceps were not to remain in place for twenty-four hours.

VI. A method not to be confounded with the one just described is Kocher's *evidement* for goitre. This is an operation very much resembling the enucleation described above as practiced by Socin, and like this latter method, is only adaptable to strumæ nodosæ. After proceeding as if for enucleation of the nodes, as soon as one of the nodes is reached, it is divided capsule and all with the knife into two halves; these are pulled apart, and each half separately removed from out of the surrounding tissue with the fingers or with a scoop. This can be done much more quickly than the above described method of enucleating the nodes, and herein lies its principal advantage. [We may compare these two methods of removing the nodes from goitres with two methods frequently practiced in the removal of sebaceous cysts from the scalp. The operation by which we first cut through the skin only, and then with blunt force take out the cyst with its sac entire, corresponds to the enucleation. The other method of cutting down upon the tumor from its apex to its base, through the skin and the sac and its contents, with subsequent removal of the growth, corresponds to the *evidement* just described.]

This method has also been termed evacuation, which term



is, in the opinion of the present writer, better limited to the operation published by Hahn. Bottini has claimed priority for this method of evidentment, but Kocher insists it is original with himself.

VII. We must now mention a method which we may call temporary elastic deligation of the goitre (during enucleation), which was first described by Bose.

The incision extends from the sternum over the apex of the tumor; most frequently therefore running towards the angle of the lower jaw, upward and downward. The superficial fascia, the platysma and the muscles overlying the thyroid body are cut. The capsule of the gland is now laid bare and made free as much as possible on all sides, from the loose connective tissue surrounding it. One entire lobe of the gland is then pulled out of the wound as far as possible, and at the point where it passes through the incision in the skin, an elastic ligature of the size of the little finger is applied and drawn tight. The incisions are made and the nodes enucleated as described under the heading enucleation. The only difference between this and Socin's method being in the fact that here we have the advantage of a bloodless operation, especially when the dissection down to the capsule of the nodes is made, and can therefore perform it more leisurely, which is of importance in those cases where the tissue surrounding the nodes is thin. The hæmorrhage after removal of the constricting rubber is said not to be at all great, no tampon being necessary. In three cases only one artery had to be tied. The cavities are finally disinfected, a drainage tube placed in a dependent position, sutures applied to the capsule of the gland, to the muscles and to the skin all separately, and the dressing left on for two days. Care should be taken not to apply the ligature too close to the trachea, for fear of squeezing out the contents of the nodes.

A method published by J. Wolff and used by him successfully in three cases, which consists in treating the hæmorrhage by simple compression with iodoformized gauze during the enucleation of nodes—compression being maintained by the assistants at one point while the operation is progressing at another—has met with so much adverse criticism by experi-

enced operators, that it suffices to simply mention it here. The chief danger consists in secondary hæmorrhage, which may be brought about at any time by choking or vomiting on the part of the patient.

VIII. Within the past few years an operative method for the cure of goitre introduced by Wölfler has gained more and more notice.

This consists not in the removal of any portion of the tumor but simply in the ligation of the large arteries supplying the gland. The first successful case of ligation of these arteries was done in 1850 by Porta, although it had been previously theoretically considered by many surgeons. Wölfler's first case was published in 1886. He had tied both arteries of the one side for goitre and after seven months the part operated upon had diminished to more than half the original size, and the other half not operated upon had also become smaller. No gangrene occurs after ligature of all the larger arteries supplying the gland. Enough nutrition is still carried to it by the little *arteria crico-thyreoidea media* originating from the anastomosis of the superior laryngeal and crico-thyroid arteries of both sides. The collateral circulation is also supplied by the *œsophageal* and *tracheal* arteries.

Wölfler has given special attention to this point, and has examined microscopically a number of specimens obtained from the post-mortem table and after experiments on dogs. He has shown that coagulation-necrosis takes place and absorption occurs very slowly without any sloughing or gangrene. A slight elevation of temperature and icterus generally occurs after the operation, owing to the absorption accompanying the necro-biotic process. In case collateral circulation is too freely established after the ligature of the thyroid arteries, a recurrence may result. Generally, however, the tumor turns into a small mass of firm cicatricial tissue, after the lapse of one year and a half. The operation itself is of no avail in malignant disease of the thyroid body, but is especially applicable to those forms of goitre which we have designated as aneurysmatic or vascular goitres, and for gelatinous forms, especially when they are recent. Cystic or indurated tumors are not amenable to treatment by this method.

The technique of this operation is generally acknowledged to be very difficult—much more so than any method of extirpation of the tumor. Billroth speaks of the operation as interesting on account of its difficulties.

Wölfler gives several methods of performing the operation. We first consider the ligation of the superior thyroid artery. We here have two methods, the first of von Langenbeck, the second of Walther. In the first the incision through the skin is made parallel to the sterno-mastoid muscle over its anterior border, toward the thyroid cartilage. The artery is found lying immediately beneath the platysma and in the triangle formed by the omo-hyoid (in front), the digastricus (above), and the sterno-mastoid (posteriorly)—known as the superior carotid triangle of the neck—and may be here ligated.

Walther, however, has shown that these normal relations change, when one lobe of the thyroid gland is much enlarged in its upper portion. In this case the artery can be better reached at the anterior border of the omo-hyoid muscle.

Rydygier proposes to expose both superior thyroid arteries by one transverse incision.

We now turn to the ligation of the inferior thyroid arteries, the most difficult part of the operation.

The method of Velpeau, Porta (and Wölfler) consists in ligating the artery at a point just anterior to where it crosses the common carotid artery, between the latter and the tumor. Langenbeck and Dietrich advise its seizure at the anterior border of the scalenus anticus muscle, and, consequently, behind the carotid. To this end the initial incision is made between the two heads of the sterno-mastoid muscle; the internal jugular vein is to be laterally displaced, and then the anterior border of the scalenus located, care being taken to avoid the subclavian vein.

The third method is known as Wœlfier's method, and consists in tying the inferior thyroid at the point where it curves around and alters its course from the perpendicular to the horizontal (transverse), corresponding to the level of the carotid tuberculum; or else at a point about three-quarters of an inch below this one, on a level with the cricoid cartilage, and behind the former.

The incision is made on the side of the neck, between the two heads of the sterno-mastoideus, and externally (posteriorly, to the carotid). This incision extends from a point on a level with the cricoid cartilage downwards to the clavicle, and intersects the clavicle at the junction of the internal third with the external two-thirds of that portion of the clavicle situated internally to the delto-pectoral sulcus. The platysma is now divided, the veins crossing the incision, the v. transversa colli; the transversa scapulæ, and the external jugular vein are ligated, and the deep fascia is incised. In the upper part of the incision, which may be lengthened by splitting the sterno-mastoid still further upwards, the tendon of the omo-hyoid muscle now appears, and may be cut or pulled to one side. The border of the internal jugular vein now presents, and must be displaced internally, towards the median line. The pneumo-gastric nerve and the external border of the common carotid artery are now seen. The scalenus anticus may now be observed at the bottom of the wound, covered over with fascia, and laterally the phrenic nerve, which is to be pulled to one side. The anterior border must now be found, and here the posterior border of the inferior thyroid artery is seen and ligated. In this manner neither the subclavian vein nor artery are encountered.

Billroth's method somewhat resembles the one just described; but he makes the incision at the external border of the sterno-mastoid muscle; and the method ascribed to Drob-nik by Obalinski also consists in seeking the artery through an incision along the external border of the sterno-mastoid, externally to the jugular vein, close to the scalenus anticus muscle.

Rydygier, who has performed the operation some sixteen times and with excellent success, advises the use of a transverse incision for exposing the inferior thyroid arteries. This incision is to be from three to four inches in length, parallel to the clavicle and just above it. It intersects the posterior border of the sterno-mastoid muscle, the smaller portion of the incision lying transversely upon the muscle itself. The incision is now carried through the platysma and the fascia of the neck, and the loose connective tissue under the sterno-

mastoid muscle severed by dry dissection with the finger, until the interior border of the scalenus anticus muscle is well exposed in the wound. A blunt retractor is now used to displace the large vessels and the pneumo-gastric nerve together with the muscle, to the front, forward and inwards. The phrenic nerve may be seen coursing over the scalenus muscle. In the bottom of the wound the ascending and superficial cervical arteries are plainly visible at their point of origin, and the inferior thyroid may be followed for some distance in its curved course, and is here to be doubly ligated.

The two superior thyroid arteries may be ligated in a similar manner by a transverse incision, one incision serving to tie both arteries.

No drainage is used; and the first dressing is allowed to remain unchanged for three weeks.

One of the objections raised to the methods of ligating the thyroid arteries for goitre is that the operation causes four unsightly scars. But Rydygier, in two cases, made but two.

IX. Among the combined methods of operating for struma, we will here only mention Kocher's combination of resection and enucleation. This method is intended to be an improvement upon the resection of goitre as described by Mikulicz. As observed above, Kocher found, in ligating what has been called the pedicle of the tumor during resection, that injury to the recurrent laryngeal nerve was not always avoided, and in order to avoid this accident, and also to obviate the application of ligatures *en masse* to the stump, which may cause sloughing, he invented the following operation:

Supposing that one-half of the thyroid body was alone to be removed, and that the tumor could be classified under the heading of struma nodosa, the anterior surface of the goitre is first laid bare, and the tumor, as far as possible, made free by dry resection with blunt instruments. The veins are doubly ligated and cut, the superior and inferior thyroid arteries ligated with their veins in the same manner as described for extirpation. But in case the whole lobe is not to be removed, and it is desired to maintain the normal function of the gland, this step may be omitted. The isthmus may now be ligated; or this, too, may be omitted as unnecessary.

The tumor is now attacked from the front, at a point as near as possible to the median line, and the thin coat of parenchyma cut through until the capsule of the node is reached. The dissection now follows the median aspect of the superficies of the node until a point has been reached behind the point of attack, and well past the region where the recurrent laryngeal nerve lies in the groove between the trachea and the œsophagus. At this point, well out of the reach of the œsophagus, and at the posterior portion of the tumor, the layer of parenchymatous tissue enveloping the node is again attacked and cut through, and the incision carried downward and, so to speak, around one of the segments of the node, until it meets with the original point of attack from the front. As soon as this is done the node with its greater external portion covered with parenchyma comes away, being only adherent in its place by the untied vessels coming from behind, if there remain any untied; in this case these are now to be tied and the tumor removed. A cup-shaped portion of the gland is thus left in connection with the isthmus. The only time when hæmorrhage may be encountered is during the incisions through the parenchyma down to the capsule of the node, and then each bleeding point should be tied as it is encountered—unless the bloodless operation is done.

[The whole operation may be illustrated by imagining an orange cut away from the tree on which it is growing by incising the rind in front, at a point say an inch from the stem, in a line at right angles to the stem, then stripping off the portion of the rind near the stem from the pulp by blunt force until a point is reached two inches from the stem measured behind the orange, and, lastly, incising the rind at this point from the inside, and then joining the incisions. In this illustration the stem of the orange represents the isthmus, the rind the parenchyma, and the fruit proper, the node.]

This is Kocher's "resections-enucleation" and his operation of "resections-extirpation" is similar, the latter referring to the class of cases where no nodes are developed. In either case a mass of tissue is allowed to remain *in situ*, which should have been removed if surgical extirpation had been done. In fact both these operations bear upon them the stamp of improvisa-



tions during operations commenced after typical methods.

Having thus far reviewed the principal methods in vogue for the operation of thyroidectomy it is of some importance to determine, if possible, which method is best adapted to certain given cases. From their nature it is evident that many of the operative methods described are only applicable to certain forms of tumor. Thus enucleation can only be done for struma nodosa. Ligature of the afferent vessels is especially adapted to recent aneurismatic tumors. But the indications as to the choice of methods given by the appearance of the various tumors are by no means completely covered by such *a priori* considerations, and therefore much time and attention has been given by various authors to this interesting question.

The choice between partial and total excision of the thyroid body has been brought into greater prominence and received more serious consideration since the development of our knowledge of the disease called myxœdema.

It is well known that in certain cases of complete removal of the thyroid body, death occurs, preceded by a condition of the skin and other tissues of the body resembling œdema, but for the greater viscosity of the infiltrating fluid, owing to the presence in the latter of mucin.

The subjective symptoms of operative myxœdema consist in a sense of fatigue and lassitude, sleeplessness, deep-seated pain and chilly sensations in the limbs, gradual loss of memory and intelligence, difficulty of speech, palpitations, etc. Objectively, we find an œdematous condition of the skin, especially of the face and hands, not pitting upon pressure, and giving to the physiognomy an expression of idiocy; also a swollen condition of the mucous membranes with increased secretions, giving rise to various disorders; swelling of the tongue, etc. Anæmia is always present, and generally well marked. Sensibility is impaired; paræsthesia, neuralgia or anæsthesia may be present. The reflexes are generally diminished. All movements are labored, and disorders of co-ordination may exist. The pulse is small and soft, the circu-

lation slow, the temperature subnormal. Disorders of digestion are frequent. The urine is generally diminished in quantity, of subnormal specific gravity; in the latter stage nephritis and albuminuria are present. The memory becomes impaired; speech grows slow and labored; illusions of the senses and hallucinations occur.

The course of the disease is slow but progressive, generally lasting from six to twenty years. The first symptoms may appear after the lapse of a period of three months after operation. Death is occasioned by inflammatory changes in the lungs, nephritis, pericarditis, hepatitis, etc.

A large number, some 150, of cases of myxœdema are now on record, and where the disease appeared of its own accord, it has been ascribed to the interstitial development of fibrous tissue in the gland. In operative cases the disease was ascribed directly to the removal of the gland.

It is a curious fact, however, that some surgeons, and they not by any means such as have done the least number of total excisions, as Maas and Billroth, have never observed cases of myxœdema in their practice. The latter consequently once expressed himself as not believing that myxœdema was a consequence of total extirpation of the gland, while Maas believed the condition called myxœdema to be due to the same (miasmatic) infection which first caused goitre.

This latter view is refuted, however, by the observation frequently made since then, that myxœdema exists in districts where goitre does not occur, and in patients who never had visited such districts.

Baumgärtner and other surgeons believed the disease due to injury to the sympathetic and recurrent nerves during the operation, and consequent loss of oxygen to the brain.

Munck attributed it to irritation of the nerves encountered in the field of operation proper. But Hoffa, who, after first doubting its existence, was obliged to acknowledge it, after having observed a case in his own practice, argues that these theories would not explain why myxœdema occurred only after total and not at all after partial excisions. On the other hand it has been argued that if some surgeons did not observe myxœdema after total excision of the thyroid, that was proba-

bly either because the excision was not so complete and entire as they had believed, or else on account of the presence of accessory thyroid glands which had been overlooked, or finally, because the cases had been lost sight of and had not remained sufficiently long under observation.

Quite recently the Myxœdema Committee of the London Clinical Society, under the chairmanship of Dr. Ord, has handed in its report, after four years of labor, which renders it extremely probable that the disease of myxœdema is a direct consequence of the loss of function of the thyroid gland. In the operative cases, the committee was persuaded, the operations had been done with perfect antiseptic precautions. The final cause of the disease therefore, still remains obscure.

We have, however, by the present time numerous experiments upon animals, which throw a little more light upon these obscure conditions.

In dogs and cats loss of the entire thyroid causes death. Rabbits and rats, however, sustain loss of the entire thyroid body without any evil consequences. Apes show much resemblance to man in their behavior after being subjected to loss of the thyroid. They are attacked by muscular tremor, mucoid œdema, and idiocy, and die.

Some very interesting experiments have been performed upon cats. After removal of part of the thyroid, the excised portion was transplanted into the abdominal cavity, and in some cases it became organized and apparently continued to functionate in its location, so that the animal survived the subsequent total extirpation of the gland at the neck without any symptoms of cachexia. The gland in the abdomen was found to have become considerably smaller on subsequent examination, than when first introduced.

Transfusion of blood from a healthy animal into one suffering from operative myxœdema retards the progress of the disease; the same effect is observed after injections of the juice expressed from a healthy thyroid body. After the extirpation of the thyroid larger quantities of mucin have been found in the saliva of the submaxillary glands than normally. The names of Schiff, Wagner, Zesas, Sanquirico and Canalis, Horsley, Herzen, Albertoni, Tizzoni, Colzi, Ewald, Halstead

and others, are connected with experimental research on these questions.

As to theories which have been advanced to explain the function of the gland, there is no lack of them.

The possibility of the thyroid being a regulator for the blood-supply to the brain has been very ably sustained by some work done in His' laboratory. When we recall the anatomical fact that both the internal carotid and the vertebral arteries have a tortuous course through bony canals before entering into the cranial cavity, and that both these arteries are directly influenced as to their blood supply by the thyroid arteries, it appears plausible that the thyroid body, acting as a sponge for the instantaneous receiving of large quantities of blood, may so regulate the blood pressure in the brain as to be necessary for the proper function of this organ, especially when we bear in mind the nervous distribution to the gland. But ingenious as this theory is, it cannot readily be brought into harmony with the observations of the vicarious function of thyroid grafts for the normal gland observed by Schiff in cats.

Other theories ascribe to the gland the function of the production of blood-elements, or the destruction of some noxious element in the blood-fluid; or the furnishing of some unknown secretion necessary to the system or to the proper function of the nerves; or the supplying of some unknown and important nervous fibres belonging to the sympathetic system.

The theory apparently the most probable is that of Horsley, that the gland prevents the accumulation of mucin in the system; this being the best substantiated by experimental evidence.

However these questions may be decided in the future, this much is certain in view of the present state of experimental research—that total excision of the gland is not justifiable, if it can be avoided in the interest of the patient's life. Therefore total removal of the thyroid body should never be undertaken, excepting in such cases as malignant goitre, carcinoma or sarcoma. In some cases, however, an acute inflammation of the enlarged thyroid body is met with, which is a complication of goitre (known as thyroiditis). In these cases the

patients are not only exposed to the most acute suffering but they are in actual danger of their life from suffocation. In these cases, therefore, unless the goitre be cystic in character, total extirpation is called for.

In all other cases, however, partial excision only is justifiable, the excision being limited to one-half of the organ, otherwise enucleation of nodes or resection being done.

The method preferred in each case will be best decided by the diagnosis.

If we have to deal with a simple form of struma nodosa—and this is the most frequent case—we elect the operation described as enucleation. In fact, some authors propose attacking every case with a view to performing enucleation of the nodes, taking their presence for granted; and only when this method fails, do they secondarily resort to other methods (resection).

If we recognize large hard nodes situated in a thyroid body which has become adherent to the underlying tissues, and cannot be manipulated without danger of suffocation to the patient (on account of the undue traction on the trachea, softened by pressure), enucleation is indicated. But if the nodes are of a softer and more vascular character, so that much hæmorrhage is encountered on enucleating in consequence of the arteries leading into the capsule being too numerous, evidement is the quicker and cleaner method. Especially is evidement to be substituted for enucleation in case one of these soft nodes should be ruptured during the operation. The presence of adhesions between the tumor and the softened trachea, therefore, materially affects the indications, since these conditions frequently render dispatch imperative. For these reasons very hard nodes which cannot be easily detached from the surrounding tissues may also be more readily removed by evidement.

Now, it may happen, in case enucleation is undertaken, that the nodes prove to be present in very great numbers, although individually of small size, so that in spite of the fact that the proposed enucleation may prove sufficiently easy of performance, the time necessary for the completion of the operation proves too long. In such a case, too, evidement permits of

more rapid work, and should be substituted for the enucleation, especially when the nodes are well isolated, so that little hæmorrhage occurs on splitting them. But if the nodes are extremely small, and present in great quantities, partial extirpation is the quickest and most satisfactory method.

For vascular hyperplasia of the thyroid gland as described above, whether it appears in the aneurismatic or varicose form, deligation of the large arteries supplying the gland should be undertaken. If the condition is more prominent on one side, both the superior thyroids and one inferior thyroid artery may be ligated in the first sitting, and only in case prompt recovery does not result need the other inferior and ima be tied. The reason for this delay lies in the fact that some surgeons (Kocher) are fearful of the occurrence of myxœdema after ligation of all arteries. These considerations, together with the technical difficulty attached to the deligation of the arteries, have combined to discredit the performance of this operation for parenchymatous goitres, for the softer and more recent forms of which it was formerly considered indicated by some surgeons.

For the cases described above as hypertrophy (and especially where we encounter diffuse hypertrophy, a proliferation both of the parenchyma and the interstitial tissue), partial extirpation is indicated, provided that a portion of the gland is unaffected, and may be left *in situ*. If not, resection is indicated.

There may occur cases in which it is impossible to make a diagnosis, and when the surgeon remains in doubt what he has to deal with. In such cases, resection is indicated, because this method is generally safe; there is no need of an exact knowledge of the condition of the other lobe—nor is it necessary to ligate the inferior thyroid artery, nor to dissect out the recurrent nerve.

One class of goitres has not as yet been considered in the foregoing pages—the cystic goitre. We refer especially to those cases where one large cyst is responsible for the increased size of the gland. The operations for cystic goitre are several: Puncture with injection of some medicinal fluid; inci-



sion, with subsequent stitching of the sac to the skin, and drainage; enucleation of the sac entire; these are the methods most frequently in use at the present time. Of the methods in which iodine tincture plays a part little need be said, on account of the loss of favor which this procedure has met with since the introduction of more rapid methods. Although a number of cases are still reported in the journals, where recovery takes place after iodine injections, yet many cases of mishaps have also been published. Hæmorrhage ending in death, acute inflammation with suppuration, acute asphyxia with fatal result, are among the published consequences following iodine injections. In any case the use of injections of iodine causes adhesive inflammations to take place about the sac, and this condition renders subsequent operations by rapid methods very difficult or impossible, not to speak of the valuable time lost.

The objections which may be raised to the method of operating upon cystic goitres by incision with parietal suturing and drainage, sometimes spoken of as Beck's method, are, first, the liability of hæmorrhage occurring from the middle of the cyst. We know that the villi projecting into the lumen of the sac contain quite large blood vessels, and that degenerative processes are constant here. In fact, as remarked above, it is not improbable that these cysts originate and grow by means of hæmorrhages. The second objection is the length of time necessary to complete recovery after the operation, especially if the capsule of the cyst is much thickened. These objections do not hold good in regard to operations done at an emergency for threatened asphyxia, when the incision, or even aspiration, is sure to give instantaneous relief—a method frequently called into use on account of the proneness of large cysts to acute inflammations.

The favorite method of operating for cysts, and a very easy and rapid one, is the enucleation of the sac entire. This method has been associated with the name of Juillard, Burckhardt, E. Müller and others. The finding of the sac is not difficult, owing to its thickness, and the course of the blood-vessels on its walls, referred to above.

The incision through the skin may be made along the anterior border of the sterno-mastoid muscle, or in the median line, according to the location of the cyst. The fascia covering the gland is first incised, and then the layer of parenchymatous tissue intervening between the capsule of the gland and the sac of the cyst is to be cut through. Here some hæmorrhage may be encountered and should be arrested as one proceeds. This layer may, however, be extremely thin, like blotting paper, and may more or less resemble connective tissue, owing to atrophy from pressure. When the capsule of the cyst is reached it is easy to enucleate the whole sac complete. Care should be taken not to rupture it, in which case it is best to split the cyst open and afterwards dissect out the capsule.

The wound should then be closed in the usual way; and recovery is generally completed in two weeks on the average.

In conclusion, we may now present the choice of a method of operation for all kinds of goitre (excepting exophthalmic goitres) in the following manner:

Large nodes in simple goitres: enucleation; in case this operation proves impracticable, resection is to be substituted for it.

Nodes in immovable goitres, where there is some danger of suffocation: enucleation; in case the danger increases, evidence is to be substituted.

Very soft nodes in simple or immovable goitres: evidence (for the sake of dispatch).

Large number of small nodes: partial extirpation. If no sound tissue is present which may be left, resection is to be substituted.

Vascular tumors: ligature of arteries.

Cysts: enucleation.

Diffuse hypertrophy: partial extirpation; if no sound tissue is present which may be left, resection is to be substituted.

Malignant goitres: total extirpation—for which amputation may be substituted.

Acute thyroiditis in simple goitre: total extirpation.

Acute thyroiditis in cystic goitre: enucleation; if dispatch is necessitated, incision and drainage may be substituted.

When the nature of the tumor is not diagnosed, or if the chosen operation proves impracticable, resection.

Injections are to be reserved for cases where from one or other reason an operation is not deemed advisable.

Of the many fluids proposed for injection, iodine tincture, Lugol's solution, arsenic, ergotine, Fowler's solution, osmic acid and iodoform, the latter appears most worthy of trial since its warm recommendation by von Mosetig-Moorhof. The method was used principally for soft parenchymatous or follicular goitres and gave excellent results. The solution consisted of iodoform, one gram; and ether and olive oil, equal parts, seven grams. One or two grams or more (mxxv-xxx) were injected in intervals of from three to eight days, in all from five to ten times.

The indications for operative interference in goitrous tumors have been given as follows:

1. Suffocatory symptoms.
2. Difficulty of respiration; even when labored respiration only appears after exertion.
3. Rapid growth of the tumor.
4. Difficulty in swallowing.
5. Interference with the patient's usefulness, or his enjoyment of life. (Maas.)

Age does not form a contra-indication to the operation.

The complications which may occur during operation are: (1) hæmorrhage; (2) gross lesions of the nerves, especially the sympathetic, the pneumo-gastric, the hypoglossal, and the recurrent laryngeal nerve, (3) injuries to the adjacent organs, especially the œsophagus and the trachea.

Those directly following are (1) the inflammatory or (2) septic complications; such as aphonia due to tumefaction of the mucous membrane, and acute suppuration of the visceral space of the neck, with cellulitis and consequent burrowing of pus and anterior mediastinitis.

Among the more remote consequences of thyroidectomy are (1) acute mania following operation; (2) epilepsy; (3) tetany; (4) hysteria; and (5) myxœdema; (6) recurrence of malignant tumors *in loco* and elsewhere, with adhesion of the capsule to the growth, envelopment of the large veins of the neck and the nerves in the growth, extension below the sternum, etc. These complications and sequelæ of thyroidectomy are to be treated according to general surgical principles, so that their mere mention suffices here.

The question regarding the advisability of performing tracheotomy in cases of thyroidectomy has been answered in the negative by almost all operators of experience; and the operation is only done at the present time during the excision of goitre to meet a vital indication. It is hoped by carefully avoiding tracheotomy to insure a more certain condition of asepsis in the wound, which could not so readily be done were the secretions from the mucous membrane of the trachea allowed to enter the wound.

If tracheotomy is not done, however, much care is to be bestowed upon the trachea during operation, and especially when by compression through the tumor it has become changed in shape and rendered soft. Two sutures are frequently inserted, one in either side of the trachea, and traction maintained upon them during operation, so that the tube is prevented from collapsing with the movements of the tumor. Or else the sutures may be tied together over the front of the trachea, with a view to maintaining its lumen oval. The sutures should not be passed through the mucous lining of the trachea, but only below the cartilaginous rings.

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